

FORM PTO-1390 (REV. 10-94)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER 8436.82USWO
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371			U.S. APPLICATION NO. (If known, see 37 CFR 1.5) unknown <b>09/787051</b>
INTERNATIONAL APPLICATION NO. PCT/AU99/00772	INTERNATIONAL FILING DATE September 14, 1999	PRIORITY DATE CLAIMED September 15, 1998	
TITLE OF INVENTION COLLECTORLESS FLOTATION			
APPLICANT(S) FOR DO/EO/US MANLAPIG et al.			
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:			
<ol style="list-style-type: none"> <li>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</li> <li>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</li> <li>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) <ol style="list-style-type: none"> <li>a. <input checked="" type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US)</li> </ol> </li> <li>6. <input type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</li> <li>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input type="checkbox"/> have been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</li> <li>d. <input checked="" type="checkbox"/> have not been made and will not be made.</li> </ol> </li> <li>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</li> <li>9. <input checked="" type="checkbox"/> An unsigned oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).</li> <li>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</li> </ol>			
<b>Items 11. to 16. below concern document(s) or information included:</b>			
11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.			
12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.			
13. <input checked="" type="checkbox"/> A FIRST preliminary amendment <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.			
14. <input type="checkbox"/> A substitute specification.			
15. <input type="checkbox"/> A change of power of attorney and/or address letter.			
16. <input checked="" type="checkbox"/> Other items or information: 7 sheets of formal drawings; Form PCT/ISA/210; Form PCT/IB/304; Form PCT/IPEA/409			

U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5) unknown <b>09, 787051</b>	INTERNATIONAL APPLICATION NO. PCT/AU99/00772	ATTORNEY'S DOCKET NUMBER 8436.82USWO
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17. ☒ The following fees are submitted:

**BASIC NATIONAL FEE (37 CFR 1.492(a) (1)-(5)):**

Search Report has been prepared by the EPO or JPO.....\$860.00

International preliminary examination fee paid to USPTO  
(37 CFR 1.492(a)(1)).....\$690.00

No international preliminary examination fee paid to USPTO (37 CFR 1.482)  
but international search fee paid to USPTO (37 CFR 1.445(a)(2)).....\$710.00

Neither international preliminary examination fee (37 CFR 1.482) nor  
international search fee (37 CFR 1.445(a)(3)) paid to USPTO ..... \$1000.00

International preliminary examination fee paid to USPTO (37 CFR 1.482)  
and all claims satisfied provisions of PCT Article 33(2)-(4) .....\$100.00

**CALCULATIONS** PTO USE ONLY

**ENTER APPROPRIATE BASIC FEE AMOUNT =** \$1000.00

Surcharge of \$130.00 for furnishing the oath or declaration later than [ ] 20 [ ] 30  
months from the earliest claimed priority date (37 CFR 1.492(e))

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE
Total claims	20	-20 = 0	X \$18.00
Independent claims	2	-3 = 0	X \$80.00

MULTIPLE DEPENDENT CLAIM(S) (if applicable) + \$260.00

**TOTAL OF ABOVE CALCULATIONS =** \$1000.00

Reduction by 1/2 for filing by small entity, if applicable. Small entity status is claimed  
pursuant to 37 CFR 1.27

**SUBTOTAL =** \$1000.00

Processing fee of \$130.00 for furnishing the English translation later than [ ] 20 [ ] 30  
months from the earliest claimed priority date (37 CFR 1.492(f)).

**TOTAL NATIONAL FEE =** \$1000.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be  
accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property

**TOTAL FEES ENCLOSED =** \$1000.00

Amount to be: refunded	\$
charged	\$

- a. ☒ Check(s) in the amount of \$1000.00 to cover the above fees is enclosed.
- b. ☐ Please charge my Deposit Account No. \_\_\_\_\_ in the amount of \$ \_\_\_\_\_ to cover the above fees.  
A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any  
overpayment to Deposit Account No. 13-2725.

**NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.**

SEND ALL CORRESPONDENCE TO  
Brian Batzli  
MERCHANT & GOULD  
P.O. Box 2903  
Minneapolis, MN 55402-0903

SIGNATURE: Curtis B. Hamre

NAME: Curtis B. Hamre

REGISTRATION NUMBER: 29,165

09/787051

JC08 Rec'd PCT/PTO 13 MAR 2001

S/N unknown

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

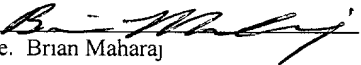
Applicant: MANLAPIG et al. Serial No.: unknown  
Filed: concurrent herewith Docket No.: 8436.82USWO  
Title: COLLECTORLESS FLOTATION

CERTIFICATE UNDER 37 CFR 1.10

'Express Mail' mailing label number:

Date of Deposit: March 13, 2001

I hereby certify that this correspondence is being deposited with the United States Postal Service 'Express Mail Post Office To Addressee' service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D C . 20231

By:   
Name: Brian Maharaj

PRELIMINARY AMENDMENT

Box PCT  
Assistant Commissioner for Patents  
Washington, D. C. 20231

Dear Sir:

In connection with the above-identified application filed herewith, please enter the following preliminary amendments:

IN THE ABSTRACT

Insert the attached Abstract page into the application as the last page thereof.

IN THE SPECIFICATION

A courtesy copy of the present specification is enclosed herewith. However, the World Intellectual Property Office (WIPO) copy should be relied upon if it is already in the U.S. Patent Office.

IN THE CLAIMS

Please cancel claims 21 and 22.

09/787051

Please amend claims 3-15 and 20 as follows:

3. (amended) A process according to claim 1 wherein flotation in the pneumatic flotation cell is conducted at a neutral or slightly oxidising Eh.
4. (amended) A process according to claim 1 wherein the Eh range is between -100mV and +200mV.
5. (amended) A process according to claim 1 wherein the Eh range is between -50mV and +100mV.
6. (amended) A process according to claim 1 wherein the residence time in the pneumatic cell is below about two minutes.
7. (amended) A process according to claim 1 wherein the residence time in the pneumatic cell is between one and two minutes.
8. (amended) A process according to claim 1 wherein the residence time in the pneumatic cell is between one and 1.5 minutes.
9. (amended) A process according to claim 1 wherein the slurry is conditioned such that it falls within the predetermined Eh range, prior to entry into the pneumatic cell.
10. (amended) A process according to claim 1 wherein the rate of flotation is such that the normally required quantity of flotation additives and reagents to achieve the desired grade and recovery are not required.
11. (amended) A process according to claim 1 wherein the pneumatic flotation cell is selected from the group consisting of Jameson cell, EKOF cell, Bahr cell, contact cell, Multotec turbo-column or the like
12. (amended) A process according to claim 1 wherein flotation is conducted in a near neutral and slightly alkaline environment.
13. (amended) A process according to claim 1 wherein the valuable sulphide mineral is chalcopyrite.
14. (amended) A process according to claim 1 wherein the non-valuable sulphide mineral(s) includes pyrite.
15. (amended) A process according to claim 1 wherein the Eh range within which flotation occurs is that range within which the valuable sulphide mineral may be recovered by flotation without the need of a xanthate collector.

20. (amended) A method according to claim 18 wherein concentrate from the pneumatic flotation cell is sent to a final concentrate stream with the tailings from the pneumatic flotation cell being fed to the remainder of the flotation circuit.

REMARKS

The above preliminary amendment is made to remove multiple dependencies from claims 3-15 and 20.

A new abstract page is supplied to conform to that appearing on the publication page of the WIPO application, but the new Abstract is typed on a separate page as required by U.S. practice.

Applicants respectfully request that the preliminary amendment described herein be entered into the record prior to calculation of the filing fee and prior to examination and consideration of the above-identified application.

If a telephone conference would be helpful in resolving any issues concerning this communication, please contact Applicants' primary attorney-of record, Brian Batzli (Reg. No. 32,960), at (612) 336-4755.

Respectfully submitted,

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Dated: March 13, 2001

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CBH/kas/kmg

## ABSTRACT

The present invention relates to a process for improving the recovery of valuable sulphide minerals. The process involves determining an Eh range within which the valuable sulphide mineral may be recovered by flotation without the need of a collector. The slurry is then subjected to flotation in a pneumatic cell (50) at such a speed that the slurry remains within the Eh range during flotation. The process substantially reduces or totally eliminates the need for collector. For mixed ores such as chalcopyrite/chalcocite chalcopyrite is recovered without collector, while some non xanthate collector may be required to recover chalcocite.

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"COLLECTORLESS FLOTATION"

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## TECHNICAL FIELD

The present invention relates to froth flotation and particularly, but not only, flotation processes which reduce the quantity of collector required.

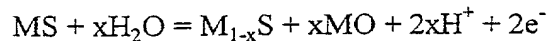
## 20 BACKGROUND ART

Froth flotation is a well-known process for separating valuable minerals from the remaining gangue in a mineral ore body. To obtain the valuable mineral, the ore is firstly ground, for example, in an AG, SAG or rod mill which is often followed by further grinding in a ball mill. The resultant slurry is then passed through a particle sizing apparatus such as a cyclone to limit the size of the particles to a predetermined value eg 0.1-.05 mm.

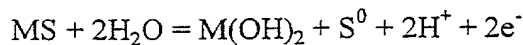
Traditionally, collectors, frothers, activators and various other additives are added to the slurry prior to its entry into the rougher/scavenger circuit where the desired valuable mineral is floated off from the remaining tail. The resultant concentrate is then fed to a cleaner/re-cleaner flotation circuit to undergo further processing. Optionally, more collector/frother may be added at this time and the slurry may be reground prior to entry into the cleaner/re-cleaner circuit.

It is vital to successful flotation to maintain the hydrophobic nature of at least the surface of the valuable sulphide mineral. This is ordinarily accomplished by adding an anionic collector to the slurry. It is important, however, to add the correct collector and in the correct amount.

5 There has to date been several previous studies in regard to collectorless flotation of minerals, for example, chalcopyrite. If chalcopyrite ore is broken in a clean environment and subjected to flotation with air in an aqueous environment, it has been shown to form a metal deficient sulphide. If the material is oxidised further it is believed that it forms iron hydroxide and elemental sulphur. The form of the equation for some metal sulphide  
10 minerals in alkaline environments is as follows:

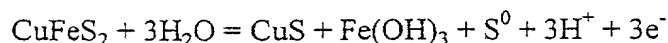


If the metal sulphide is oxidised further then the sulfur ends up being elemental sulfur as shown in the following equation:



15 The metal deficient sulphide  $M_{1-x}S$  and the sulfur element  $S^0$  are the hydrophobic species. Flotation can happen as long as the metal oxides/hydroxides formed by the reaction are solubilised. Excessive oxidation can produce thiosalts and ultimately sulphate. These ions together with the metal ions may react and re-adsorb as hydrolysis products on to the mineral producing hydrophilic surfaces.

20 With chalcopyrite the equation forming the sulfur element is:



The collectorless flotation of chalcopyrite requires that the flotation occurs in a neutral or slightly oxidising environment. Previous studies have shown that freshly fractured flotation of chalcopyrite increased when the Eh was in the neutral or slightly



- 3 -

oxidising region. The flotation process also requires that the surface of the minerals being floated be as clean as possible. Previous studies have compared the effects on flotation recovery of a freshly fractured sulphide mineral versus an ore air oxidised for three weeks. The result was that the air oxidised minerals did not achieve the same recovery as the  
5 freshly fractured minerals.

Accordingly, it would appear that collectorless flotation of sulphide minerals is less likely to proceed unless the mineral surfaces are clean and the flotation is conducted in an oxidising environment. There are a number of situations which may cause the surfaces of mineral not to remain clean including:

- 10 - iron ions (from metal balls or mill liners) in solution after the ore has been through the ball mill. These ions may then form hydroxide which may deposit on the surface of the minerals,
- recycled water containing ions that eventually react with metal ions in the system and then re-adsorb on the surfaces of the minerals.

15 There are a number of techniques which have been previously attempted to reduce the amount of these materials remaining on the surfaces of the particles including high intensity conditioning vessels and cleaning agents like sodium sulphide. Collectors like xanthate have also been suggested to perform the function of cleaning the surface of the minerals of these hydroxides in the first instance. Once the surfaces have been cleaned, the  
20 sulphide mineral can float due to the collector which attaches to the mineral making it hydrophobic.

As mentioned above, although there is some dispute, it is generally thought that collectorless flotation of certain sulphide minerals require an oxidising environment.

- 4 -

All flotation machines can be arranged to provide an oxidising environment required by the reaction to render the sulphide mineral particles hydrophobic. However, as indicated above, if oxidation proceeds too far, thiosalt and eventually sulphate may form from the sulfur oxidation which may react with a metal ion in the solution forming metal sulphide.

This is a perennial problem with conventional production mechanical flotation cells when attempting collectorless flotation. The residence time for a typical mechanical cell is about three to five minutes. This long residence time and the increased Eh in a mechanical cell causes excessive oxidation of the slurry thereby producing hydrolysis products which deposit on the surface of the minerals and may render them hydrophilic in nature ie difficult to float.

The present invention seeks to overcome at least some of the disadvantages of the prior art or provide a commercial alternative thereto.

#### DISCLOSURE OF THE INVENTION

In a first aspect, the present invention provides a process for recovery of a valuable sulphide mineral comprising, providing a slurry containing the valuable sulphide mineral, determining an Eh range within which the mineral may be recovered by flotation without the need of a xanthate collector,

and subjecting the slurry to flotation in a pneumatic cell at such a rate that the slurry remains in that Eh range during flotation.

In a preferred embodiment, flotation in the pneumatic flotation cell is conducted in a neutral or slightly oxidising environment.

- 5 -

In another preferred embodiment, the residence time in the pneumatic cell is below about two minutes, preferably between one and two minutes and most preferably between one and 1.5 minutes.

The inventive process may be conducted to reduce the quantity of collector needed or indeed totally eliminate the quantity of collector, including xanthate collectors, dithiophosphate etc.

Most preferably, the pneumatic flotation cell is a Jameson cell.

In another aspect, the present invention provides a method of improving recovery in a flotation circuit comprising adding as a scalper upstream of the flotation circuit, a pneumatic flotation cell wherein a slurry containing the valuable sulphide mineral is provided to the pneumatic cell and floated at such a rate that the slurry remains in an Eh range suitable for recovery by flotation without the need of a xanthate collector.

The applicant has found that pneumatic cells such as the Jameson cell subject of Australian patent no 677,542, are ideal for reducing or even eliminating the use of collectors in the flotation of sulphide minerals. Typical pneumatic cells have residence time of less than two minutes, preferably around one to two minutes and most preferably one to 1.5 minutes. They can provide the slightly oxidising environment needed for collectorless flotation while effecting rapid flotation so as to avoid excessive oxidation or increase of the Eh outside the required range where hydroxides are formed on the surface of the minerals.

The process kinetics of pneumatic cells eg Jameson cells, in particular, bubble production and attachment to the particles, are much quicker than conventional mechanical cells. To explain, in a Jameson cell downcomer, the bubbles are created, collide with the particles and attach to the hydrophobic surface of the valuable sulphide mineral particles in

- 6 -

approximately 30 seconds. The downcomer in a Jameson Cell generates a very high shear environment which, when combined with high air voidage (40-50%) and super-fine bubbles (400microns) result in intense and rapid particle collection.

The actual contacting time in a Jameson downcomer is only a few seconds. The  
5 slurry leaves the downcomer and enters a separation tank where the valuable sulphide mineral particles with the bubbles already attached quickly separate from the remainder of the slurry, for example, in approximately one minute, giving a total residence time preferably less than 2 minutes. On the other hand the total residence time required in conventional cells of generally at least 3 to 4 minutes is a reflection of the inherent  
10 inefficiencies of the system and the requirement for multiple contacting episodes.

Mechanical cells require bubbles to be created by a mechanical means eg an impeller. The bubble collision and attachment steps as well as the separation process all occur within the same tank. This requires a much greater residence time to allow the bubbles to be created, attached to the particles and then separate from the slurry. This greater residence  
15 time simultaneously increases oxidation and Eh of the slurry thereby reducing the effectiveness of collectorless flotation.

It should be understood that the Eh of the slurry in the Jameson Cell is essentially uncontrolled. To explain, once the determination of the appropriate Eh has been made and the slurry is within that range when it is provided to the Jameson Cell, the Eh of the slurry  
20 is allowed to fluctuate as it naturally will do so in the presence of air. Generally this will increase the Eh value due to oxidation of the particles. While Eh fluctuation of the slurry is allowed to occur naturally, the invention provides that flotation occurs so rapidly as to avoid the Eh of the slurry going outside the range for collector free flotation.

## BRIEF DESCRIPTION OF THE DRAWINGS

So that the present invention may be more clearly understood it will now be described by way of example only, with reference to the following drawings in which:

Figure 1 is a graph comparing conventional flotation techniques with those of the present invention,

Figures 2 and 3 are graphs of grade vs recovery for industrial scale test work in accordance with the present invention,

Figure 4 is a flow sheet of a mineral beneficiation process using the present inventive method,

Figure 5 is a graph showing the improvement in recovery arising from employing the present invention in a mineral beneficiation plant, and

Figures 6 and 7 are photomicrographs of the concentrate arising from the industrial scale test work shown in Figure 3.

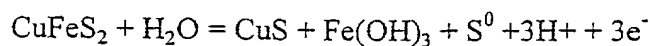
## BEST MODE(S) FOR CARRYING OUT THE INVENTION

An electrochemical investigation was firstly conducted using a specially built chalcopyrite mineral electrode immersed in water from the site where the Jameson Cell would be operated. The major aim of this investigation was to determine the electrochemical response of chalcopyrite in the aqueous environment of the concentrator where the pneumatic cell, such as a Jameson Cell, would be installed and tested and the appropriate Eh range for collectorless flotation of the ore.

A 15 litre sample of water was collected from the concentrator. Chalcopyrite and chalcocite electrodes were prepared and cyclic voltamograms were conducted using the electrode in the water from the concentrator. The cyclic voltamogram study was conducted using an ADInstrument Potentiostat driven by a MacLab 4e data acquisition system using

'Echem' software. The reference electrode used was a Ag/AgCl electrode. A platinum electrode was used as an auxiliary electrode. The electrode was cleaned prior to the scan by running it over a fine emery paper to allow a fresh surface to be available for analysis.

The gold electrode was immersed in the water from the concentrator and produced  
5 a featureless scan. However, where the chalcopyrite electrode was used, a peak around 0.1 volt was observed, indicating the oxidation of the  $S^{2-}$  to  $S^0$  from the following equation:



This result is consistent with voltamograms from Gardner and Woods (1979).

A scan of a chalcocite electrode under  $N_2$  purge in the concentrator water showed a  
10 scan indicating the following: In the anodic scan chalcocite  $Cu_2S$  is oxidised to covellite  $CuS$  at around -0.2 v. At around 0.4 v the covellite is further oxidised forming  $Cu^{2+}$  ions and most likely forming  $CuO$  and  $Cu(OH)_2$ . Beyond 0.6 v, further oxidation is seen to occur possibly forming more  $CuO$  and  $Cu(OH)_2$  on the surface of the electrode.  $Cu^{2+}$  is not  
15 stable in an alkaline environment and would form  $Cu(OH)_2$  and precipitate on the surface of the electrode. This formation of  $Cu(OH)_2$  on the surface makes chalcocite not able to float in a collectorless system at high Eh.

This scan indicates that  $S^0$  is not formed in the oxidation of  $Cu_2S$  near the region where  $S^0$  is formed in the oxidation of chalcopyrite. There is no peak occurring in the 0.1 v region of the scan, as compared to the chalcopyrite electrode.

20 The approach that may be taken in some situations where the ore contains chalcopyrite and chalcocite is to float the minerals at about say 0.1 v SHE and add a non-xanthate collector. This means that the chalcopyrite will float in "collectorless" mode using  $S^0$  and the chalcocite will float using a non-xanthate collector. This will minimise the flotation of pyrite mineral.

- 9 -

It would be appreciated that similar determination of suitable Eh range for collectorless flotation can be applied to a number of ores. Alternatively such determination may come from previous studies, literature etc. which may already have determined the appropriate Eh range for each individual ore.

5       The treatment of a chalcopyrite ore in an industrial scale pneumatic cell in a collector free environment was investigated within the electrochemical regime determined in the above electrochemical study. The present test was conducted at Site A which treats a porphyry copper ore which contains predominantly chalcopyrite as the copper mineral, as well as some amount of chalcocite. The ore also contains pyrite and siliceous gangue.

10       Porphyry copper orebodies are typically characterised by free-milling coarse-grained minerals. This allows a coarse primary grind followed by regrinding of flotation concentrates to achieve final liberation while minimising overall grinding requirements.

During primary grinding a proportion of the copper minerals will be fully liberated due to the overlapping nature of the sizing distribution of the ground material and the  
15   liberation profile of the ore. The proportion of liberated copper can be very significant. At the test site the liberation of level of the major copper minerals are at least 80%, indicating these materials could be extracted to a final product prior to regrinding processes.

Conventional flotation technology has been unable to achieve such a separation in a single unit due to the slow flotation kinetics, poor selectivity into the froth phase and the use of  
20   chemical reagents that encourage sulphide gangue activation.

To illustrate the effect that rapid kinetics and reduced collector has on the flotation system, preliminary laboratory tests were conducted using standard laboratory flotation cells at the test site. The standard test site flotation test procedure was modified to simulate fast kinetics by collecting separate concentrates over 30 second intervals. Tests were

performed using standard reagent schemes as a comparison. Examples of the results are shown in tables 1 and 2 with table 3 for comparison purposes below and graphically in Figure 1. The graph of Figure 1 clearly shows the collectorless system is on a distinctly different grade/recovery curve that more closely resembles the liberation profile. Later work using improved techniques and fresh samples actually gave improved results and showed final grade concentrates of over 30% copper were achievable.

TABLE 1  
FLOTATION TEST 1 - CHALCOPYRITE ORE FROM SITE A

PRODUCT	WT (GRS)	%Cu	%Fe	%Mo	Dist. Cu	Dist. Fe	Dist. Mo
0-30" Con	36.2	32.30	13.60	0.53	76.63	40.76	29.12
30-60" Con	9.2	16.40	8.35	1.18	9.89	6.36	16.48
0-60" Cum Con	45.4	29.08	12.54	0.66	88.52	47.12	45.6
60-90" Con	7.4	3.47	2.09	1.16	1.68	1.28	13.03
0-90" Cum Con	52.8	25.49	11.07	0.73	88.20	48.40	58.63
90-120" Con	5.7	2.58	1.14	0.76	0.96	0.54	6.58
0-120" Cum Con	58.5	23.26	10.10	0.73	89.17	48.94	85.20
120-180" Con	6.5	0.81	0.51	0.86	0.35	0.27	8.48
0-180" Cum Con	65.0	21.01	9.14	0.75	89.51	49.21	73.69
Nonfloat	1333.5	0.12	0.46	0.013	10.49	50.79	26.31
HEADS	1398.5	1.09	0.86	0.047	100.00	100.00	100.00



- 11 -

## Test 1 Conditions

	pH	ORP (mV)
CONDITIONING	11.10	9
Flot 0-30"	11.05	-28
Flot 30"-60"	11.03	-13
Flot 60"-90"	11.00	-6
Flot 90"-120"	10.95	0
Flot 120"-180"	10.69	12
NONFLOAT	11.10	-29

TABLE 2

## FLOTATION TEST 2 - CHALCOPYRITE ORE FROM SITE A

PRODUCT	WT (GRS)	%Cu	%Fe	%Mo	Dist. Cu	Dist. Fe	Dist. Mo
0-30" Con	34.5	31.60	15.20	0.61	75.25	29.35	31.24
30-60" Con	9.9	15.60	9.50	1.13	10.66	5.26	16.61
0-60" Cum Con	44.4	28.03	13.93	0.73	85.91	34.61	47.84
60-90" Con	6.7	4.11	3.74	1.15	1.90	1.40	11.44
0-90" Cum Con	51.1	24.90	12.59	0.76	67.81	36.02	59.28
90-120" Con	5.5	1.68	1.26	0.82	0.64	0.39	6.69
0-120" Cum Con	56.6	22.64	11.49	0.79	88.44	36.40	65.98
120-180" Con	6.2	0.91	0.62	0.87	0.39	0.22	8.01
0-180" Cum Con	62.8	20.49	10.42	0.79	88.83	36.62	73.98
Nonfloat	1348.2	0.12	0.84	0.013	11.17	63.38	26.02
HEADS	1411.0	1.03	1.27	0.046	100.00	100.00	100.00

- 12 -

## Test 2 Conditions

	pH	ORP (mV)
CONDITIONING	11.10	-2
Flot 0-30"	11.02	-24
Flot 30"-60"	11.08	-9
Flot 60"-90"	10.96	-1
Flot 90"-120"	10.93	2
Flot 120"-180"	10.91	11
NONFLOAT	11.02	-25

TABLE 3

CURRENT PLANTS ASSAYS FOR SITE A USING  
MECHANICAL FLOAT CELLS

		% Cu	% Fe	% Mo
Plant assays during sampling	Feed	1.13	1.24	0.093
	Prim Con	17.8	10.7	0.640
	Final Con	34.7	20.3	1.050
	Tails	0.17	0.50	0.010
Plant assays for day shift	Feed	1.29	1.24	0.054
	Prim Con	13.00	11.60	0.710
	Final Con	34.6	19.10	1.160
	Tails	0.13	0.45	0.009

While not wishing to be bound by any particular theory, the applicant believes that if the pulp potential of the slurry remains within a particular Eh range, preferably near neutral and slightly oxidising condition as well as near neutral or slightly alkaline environment, then chalcopyrite can be made to float rapidly without the need of collectors. The applicant believes that pneumatic cells and, in particular, Jameson cells, may be used successfully for ores containing chalcopyrite ( $\text{CuFeS}_2$ ) and chalcocite ( $\text{Cu}_2\text{S}$ ) as these cells

- 13 -

operate under a very short residence time. Where the ore contains both chalcopyrite and chalcocite the applicant has found that collector aided flotation may be appropriate. To explain, chalcopyrite may be floated in a "collectorless" mode using  $S^0$  with the chalcocite being floated using a non-xanthate collector. This will in turn minimise the flotation of pyrite minerals.

Plant testing at the test site using a 1,200 tonnes per day industrial scale Jameson Cell produced the results shown in Figure 2. These results followed the same trend as achieved above. This testing utilised either two or four hourly composite sampling runs and showed good consistency of results. It can be seen that the Jameson Cell results are on a distinctly different grade/recovery curve to that of the conventional cells. Further, a large proportion of the copper is available as final grade material with only a relatively small amount of material requiring further treatment.

Lime is traditionally used to depress pyrite that has been activated by xanthate collector. Since little or no xanthate is used there is no requirement to use lime for this purpose. However, it was found that using the existing frothers at Site-A an alkaline system was still required to give adequate froth conditions. It is anticipated that 30% less lime could be used with alternative frother systems.

The normal frother at the test site is a 4:2:1 blend of D250, MIBC and Pine Oil. During optimisation the frother consumption was halved when Pine Oil was eliminated from the system and a blend of 9:1 D250 and MIBC adopted. The froth conditions were greatly improved with higher product grades achieved.

Some of the test work was performed in a two stage configuration with the first stage acting as a scalper and the second as a scavenger. For example as shown in Figure 4,

- 14 -

the slurry may be initially treated by the pneumatic cell, as a scalper, producing a high grade concentrate.

Feed stream 10 is fed to a Jameson cell 50. Jameson cell 50 acts a scalper. The concentrate 52 is fed to the final concentrate stream 100 or alternatively for further concentration. The tails 53 leaving the Jameson cell are fed to a primary rougher 70. The rougher tail 73 is fed to the final tail stream 200. The concentrate 72 is reground in mill 80. The reground concentrate 82 is then fed to a second Jameson cell 60 which acts as a scalper for the cleaner circuit. The tail 63 leaving the Jameson cell is fed to a cleaner/scavenger cell 90. The concentrate 62 leaving the Jameson cell 60 is fed to final concentrate stream 100.

In the cleaner/scavenger cell 90, the concentrate 92 is recycled back to mill 80 for regrinding and feeding to the Jameson cell scalper 60. The cleaner/scavenger tails 93 is fed to the final tail stream 200.

The results from this two stage testing are shown in Figure 5. These indicate excellent recovery from the scalper and further good stability in the flotation circuit in that if the scalper recovery is low for any reason, the remaining stages recoup the losses to give a steady final recovery. The testing was performed with no xanthate collector added. In order to achieve good recoveries of composite particles, a xanthate collector may be required prior to the scavenger stage. This amount of xanthate collector would probably be similar to the usual scavenger dosage levels which would maintain the large overall reduction in collector usage.

While it is possible to reduce the residence time of mechanical cells to avoid the aforementioned over oxidation/high Eh problems, this substantially increases the capital cost for the flotation circuit. As mentioned above, conventional mechanical cells have a

- 15 -

minimum residence time of around three to four minutes. If it is desired to reduce the residence time to say two minutes, it will be necessary to reduce the size of each flotation cell which in turn will require an increase in the number of cells to maintain the same throughput. This will vastly increase the capital cost in the plant. It will be appreciated by persons skilled in the art that the simple addition of a pneumatic cell to effect collectorless flotation has a number of benefits including reducing or avoiding the costs associated with collector usage, avoiding the substantial increase in costs which would be required using conventional mechanical cells, reduce power consumption and give better control.

The normal Jameson Cell circuit design for this type of application includes three flotation stages. The target total rougher recovery at the test site is approximately 90%. The full scale testing at the test site has consistently shown that the Jameson Cell can be applied in a scalping duty. In this duty, the concentrate of the Jameson Cell which is of final grade quality can be sent directly to final concentrate. Further, the incorporation of this scalping step into copper flotation flowsheets simplifies the process remarkably.

To confirm the performances in pneumatic cell further testing was conducted on another copper porphyry concentrator at Site B. The ore treated at Site B consisted of chalcopyrite, diginite, pyrite and non-sulphide gangue minerals. Once again the test was conducted with the Jameson cell acting as a scalper in the absence of xanthate collector.

Figure 3 shows the grade recovery results from the test work at Site B. It once again indicates that the Jameson cell was able to produce clean concentrate with grades equivalent to final concentrate. In comparison, in normal operation the three conventional mechanical cells treating the ore in series provide a 25% copper concentrate equivalent recovery.

The photomicrographs shown in figures 6 and 7 show the samples recovered from flotation without and with xanthate collector respectively. The grey shade particles

- 16 -

represent copper sulphide minerals (with diginite darker than chalcopyrite) and the light almost whiter shade particles of pyrite minerals. It is clear from these photomicrographs that the sample which uses xanthate includes considerably more pyrite than the sample recovered without xanthate collectors. This is one of the clear advantages over and above  
5 conventional flotation techniques. Not only does the present invention allow flotation of certain sulphide minerals without the need of collectors but it increases selectivity over certain other selected sulphide minerals, in this case pyrite, which is normally activated by the use of xanthate collectors.

#### INDUSTRIAL APPLICATION

10 The present invention exploits the electrochemical properties of sulphide minerals with a fast rate of flotation in a pneumatic cell such as a Jameson Cell. The combination achieved high recovery and excellent selectivity against gangue. Using conventional techniques, the Eh range at which certain ores can be made hydrophobic ie floatable, without the need of a collector is determined. This information is then utilised in industrial  
15 environment to recover such ores without the addition of costly collector and with substantial improvement over conventional techniques. The process has significant implications on the design and operation of concentrators including reduction in reagent consumption, reduction in flotation cell and regrinding requirements and production of a coarser finer concentrate product which has additional implications on filtering and drying.

20 While the present invention has been described by way of reference to Jameson cells, any pneumatic flotation apparatus may be used for the present invention, for example, EKOF cell, Bahr cell, contact cell, Multotec turbo-column etc.

- 17 -

It will be clear to persons skilled in the art that the present invention may be embodied in forms other than that specifically described herein without departing from the spirit or scope of the invention.

## CLAIMS:

1. A process for recovery of a valuable sulphide mineral comprising:  
providing a slurry containing the valuable sulphide mineral and determining an Eh  
range within which the mineral may be recovered by flotation without the need of a  
5 collector,  
and subjecting the slurry to flotation in a pneumatic cell at such a rate that the slurry  
remains within the Eh range during flotation.
2. A process according to claim 1 wherein the slurry contains both a valuable sulphide  
mineral and non-valuable sulphide mineral(s), the slurry being subjected to flotation in a  
10 pneumatic cell at such a rate that flotation of the selected non-valuable mineral(s) is  
reduced or eliminated.
3. A process according to claim 1 or 2 wherein flotation in the pneumatic flotation cell  
is conducted at a neutral or slightly oxidising Eh.
4. A process according to any of the preceding claims wherein the Eh range is between  
15 -100 mV and +200 mV.
5. A process according to any one of the preceding claims wherein the Eh range is  
between -50mV and +100mV.
6. A process according to any one of the preceding claims wherein the residence time in  
the pneumatic cell is below about two minutes,
- 20 7. A process according to any one of the preceding claims wherein the residence time in  
the pneumatic cell is between one and two minutes.
8. A process according to any one of the preceding claims wherein the residence time in  
the pneumatic cell is between one and 1.5 minutes.



- 19 -

9. A process according to any one of the preceding claims wherein the slurry is conditioned such that it falls within the predetermined Eh range, prior to entry into the pneumatic cell.
10. A process according to any one of the previous claims wherein the rate of flotation is such that the normally required quantity of flotation additives and reagents to achieve the desired grade and recovery are not required.
11. A process according to any one of the preceding claims wherein the pneumatic flotation cell is selected from the group consisting of Jameson cell, EKOF cell, Bahr cell, contact cell, Multotec turbo-column or the like.
- 10 12. A process according to any one of the preceding claims wherein flotation is conducted in a near neutral and slightly alkaline environment.
13. A process according to any one of the preceding claims wherein the valuable sulphide mineral is chalcopyrite.
14. A process according to any of the preceding claims wherein the non-valuable sulphide mineral(s) includes pyrite.
- 15 15. A process according to any one of the preceding claims wherein the Eh range within which flotation occurs is that range within which the valuable sulphide mineral may be recovered by flotation without the need of a xanthate collector.
16. A process according to claim 13 wherein the mineral ore further includes chalcocite.
- 20 17. A process according to claim 14 wherein the chalcocite is also floated using a non-xanthate collector.
18. A method of improving recovery in a flotation circuit comprising adding as a scalper upstream of the flotation circuit, a pneumatic flotation cell wherein a slurry containing the valuable sulphide mineral is provided to the pneumatic cell and floated at such a rate that

- 20 -

the slurry remains in an Eh range suitable for recovery by flotation without the need of a collector.

19. A method according to claim 18 wherein the rate of flotation is selected such that residence time in the pneumatic cell is below about two minutes.

5 20. A method according to claim 18 or 19 wherein concentrate from the pneumatic flotation cell is sent to a final concentrate stream with the tailings from the pneumatic flotation cell being fed to the remainder of the flotation circuit.

21. A process for recovery of a valuable sulphide mineral substantially as herein described with reference to any one of the examples or any one of the accompanying  
10 drawings.

22. A method of improving recovery in a flotation circuit substantially as herein described with reference to any one of the examples or any one of the accompanying drawings.

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T0490 T5028250

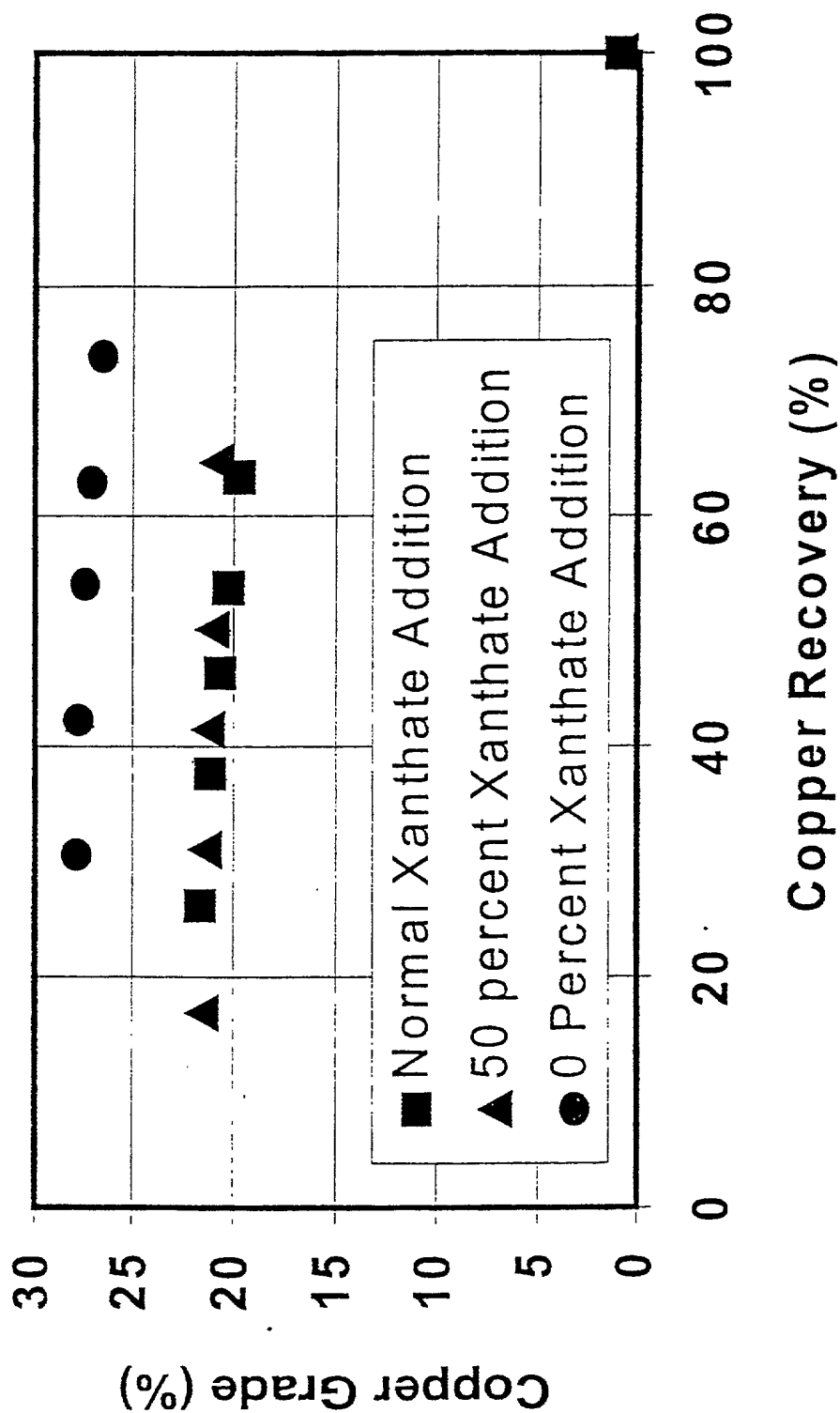


FIG 1

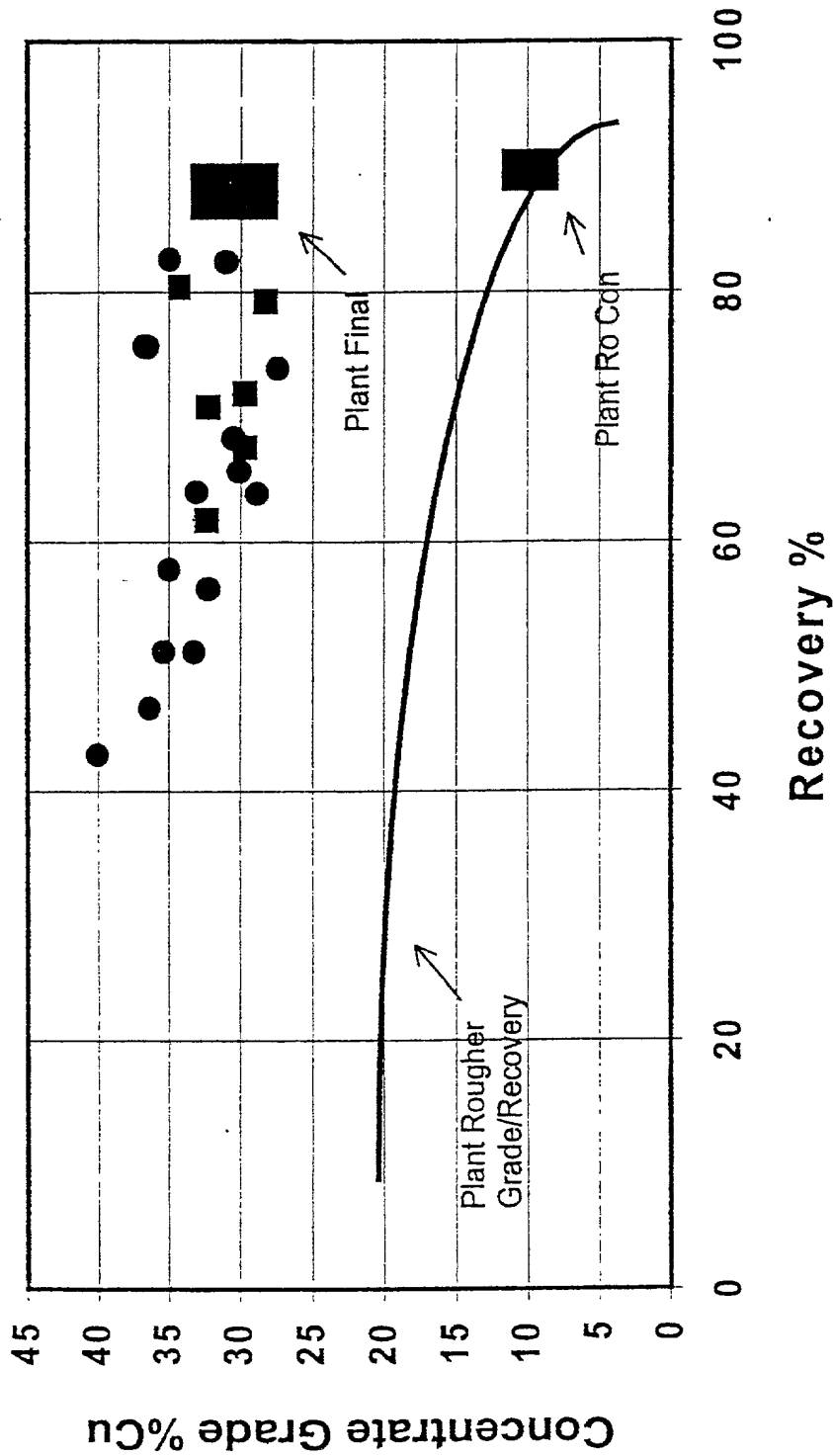


FIG 2

3/7

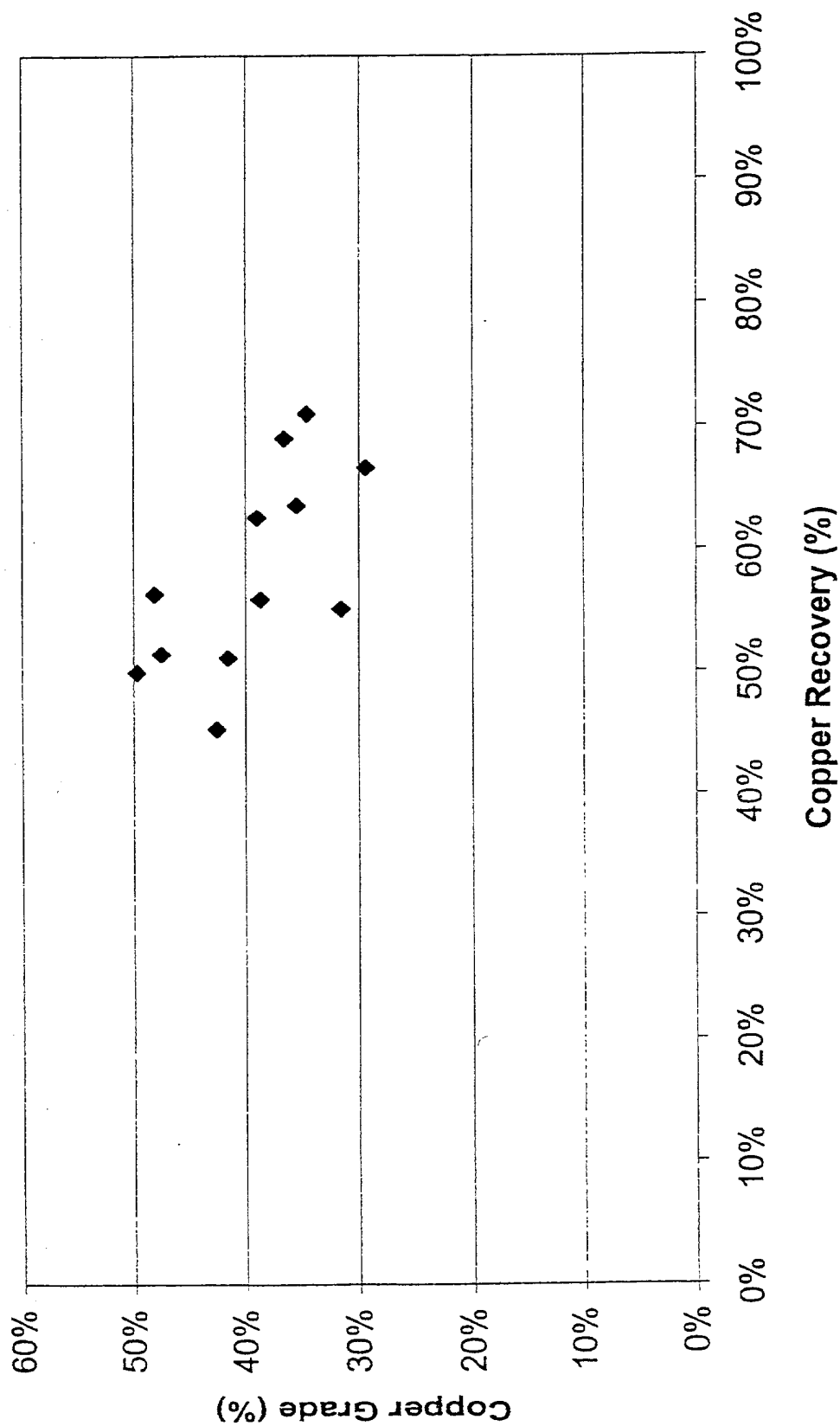


FIG 3

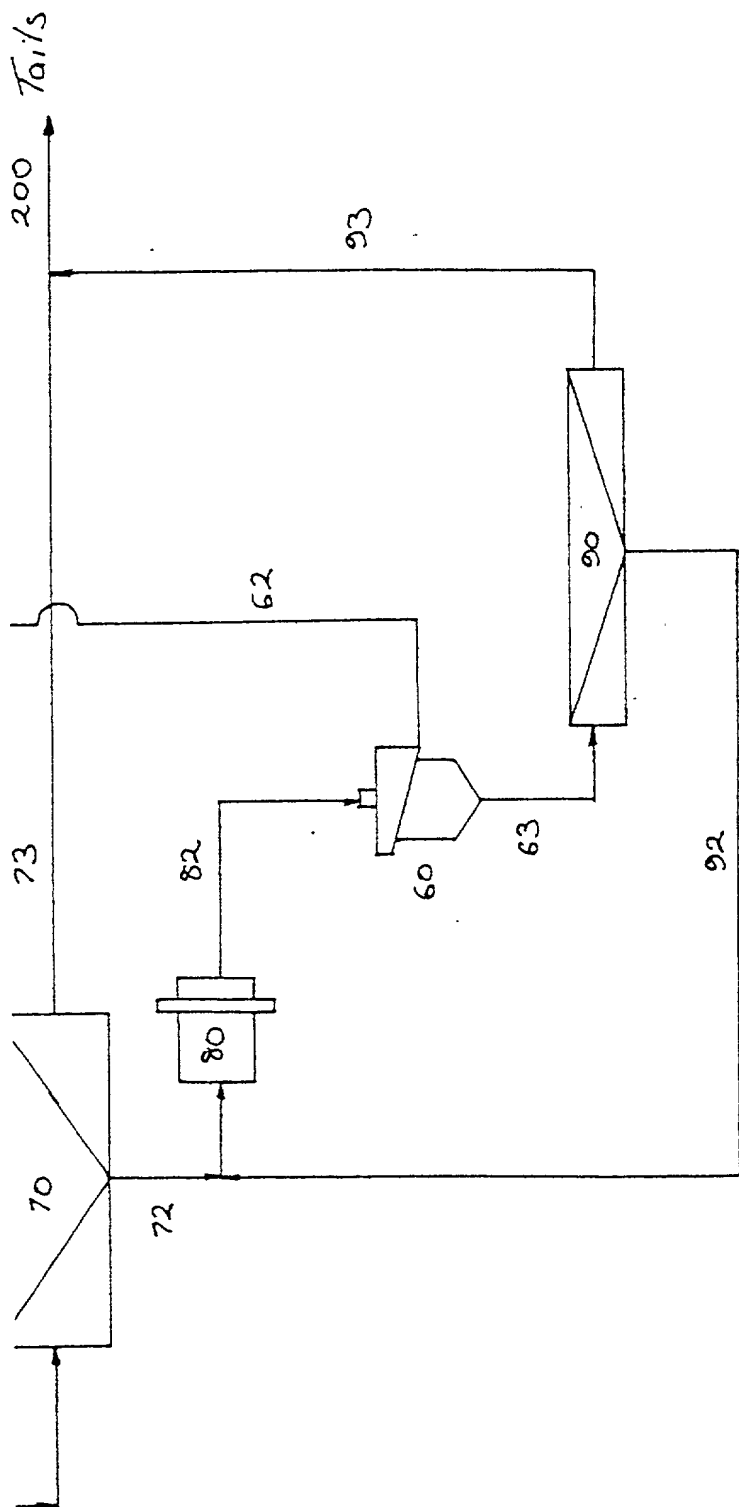


FIG 4

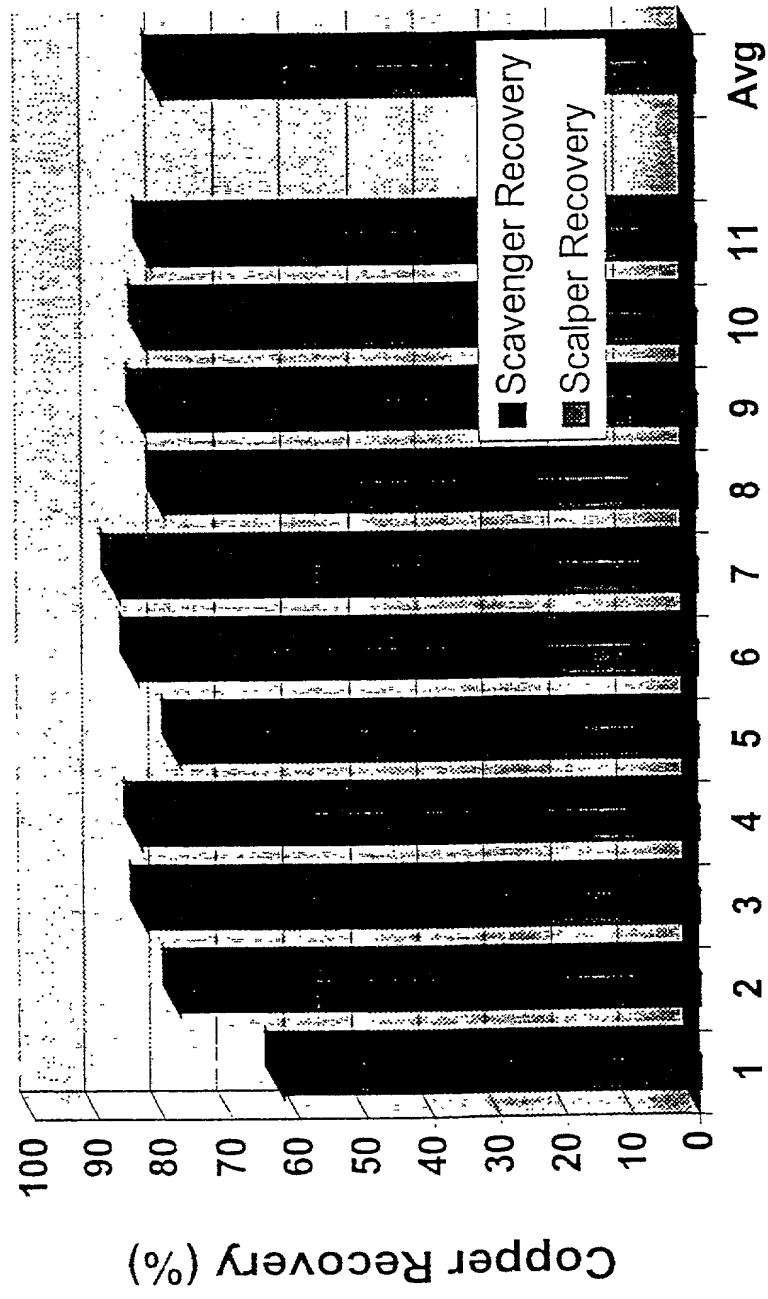
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Test Number

FIG 5

6/7

Chalcopyrite  
rimmed by  
digenite

pyrite

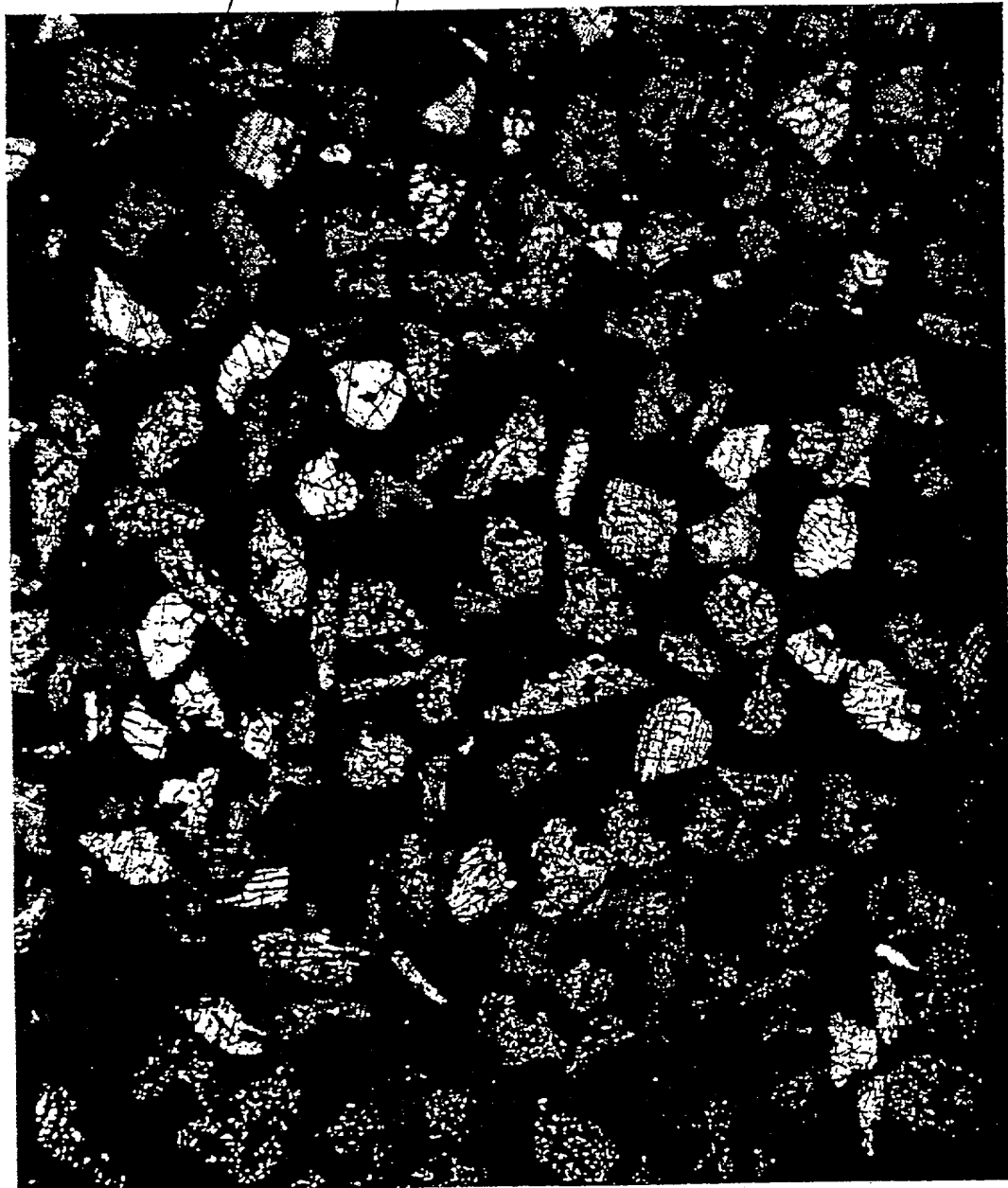


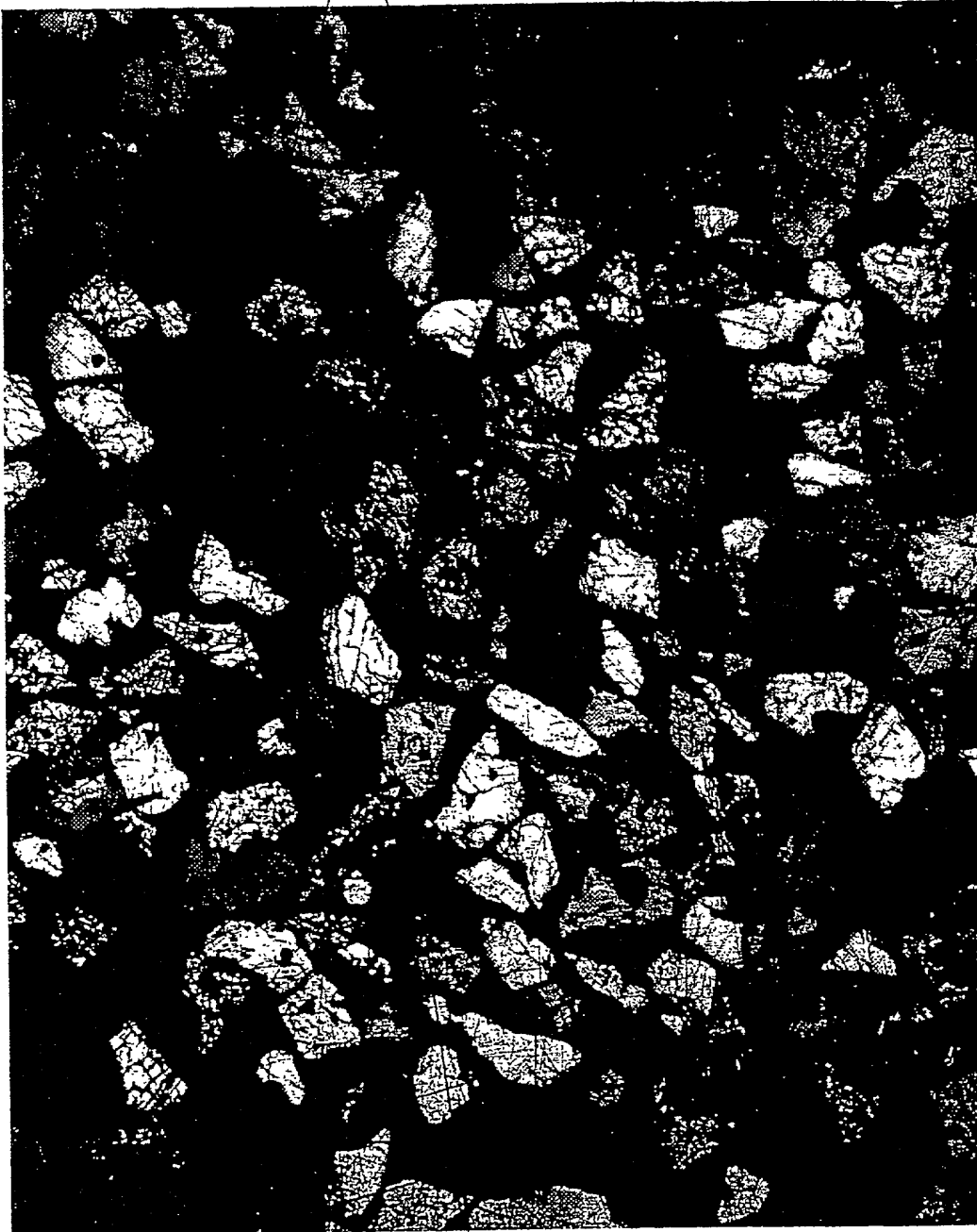
FIG 6

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7/7

pyrite

Chalcopyrite  
rimmed by  
digenite

chalcopyrite

FIG 7



Attorney Docket No. 8436.82USWO

MERCHANT & GOULD P.C.

United States Patent Application

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that

I verily believe I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: COLLECTORLESS FLOTATION

The specification of which

- a. ☐ is attached hereto  
b. ☒ was filed on March 13, 2001 as application serial no. and was amended on (if applicable) (in the case of a PCT-filed application) described and claimed in international no. PCT/AU99/00772 filed September 14, 1999 and as amended on (if any), which I have reviewed and for which I solicit a United States patent.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119/365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on the basis of which priority is claimed:

- a. ☐ no such applications have been filed.  
b. ☒ such applications have been filed as follows:

FOREIGN APPLICATION(S), IF ANY, CLAIMING PRIORITY UNDER 35 USC § 119			
COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	DATE OF ISSUE (day, month, year)
Australia	PP 5943	September 15, 1998	
ALL FOREIGN APPLICATION(S), IF ANY, FILED BEFORE THE PRIORITY APPLICATION(S)			
COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	DATE OF ISSUE (day, month, year)

I hereby claim the benefit under Title 35, United States Code, § 120/365 of any United States and PCT international application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. APPLICATION NUMBER	DATE OF FILING (day, month, year)	STATUS (patented, pending, abandoned)

I hereby claim the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below:

U.S. PROVISIONAL APPLICATION NUMBER	DATE OF FILING (Day, Month, Year)

I acknowledge the duty to disclose information that is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, § 1.56 (reprinted below):

**§ 1.56 Duty to disclose information material to patentability.**

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is canceled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is canceled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) the closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim;

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

(e) In any continuation-in-part application, the duty under this section includes the duty to disclose to the Office all information known to the person to be material to patentability, as defined in paragraph (b) of this section, which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby appoint the following attorney(s) and/or patent agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith:

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Leon, Andrew J.	Reg. No. <u>46,869</u>	Zeuli, Anthony R.	Reg. No. <u>45,255</u>

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I understand that the execution of this document, and the grant of a power of attorney, does not in itself establish an attorney-client relationship between the undersigned and the law firm Merchant & Gould P.C., or any of its attorneys.

Please direct all correspondence in this case to Merchant & Gould P.C. at the address indicated below:

Merchant & Gould P.C.  
P.O. Box 2903  
Minneapolis, MN 55402-0903



I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

201	Full Name Of Inventor	Family Name <u>Manlapig</u>	First Given Name <u>Emmanuel</u>	Second Given Name <u>Salvador Viana</u>
	Residence & Citizenship	City <u>Chapel Hill</u>	State or Foreign Country <u>QLD</u>	Country of Citizenship <u>Australia</u> <i>ACR</i>
	Mailing Address	Address <u>8 Tucker Street</u>	City <u>Chapel Hill</u>	State & Zip Code/Country <u>QLD 4069 Australia</u>
Signature of Inventor 201: <i>[Signature]</i>			Date: <u>9/05/2001</u>	
202	Full Name Of Inventor	Family Name <u>Vargas</u>	First Given Name <u>Alfredo</u>	Second Given Name <u>Percy</u>
	Residence & Citizenship	City <u>La Paz</u>	State or Foreign Country <u>Bolivia</u>	Country of Citizenship <u>Bolivia</u>
	Mailing Address	Address <u>Calle 4A, No. 23 Meseta Achumani</u>	City <u>La Paz</u>	State & Zip Code/Country <u>Bolivia</u>
Signature of Inventor 202:			Date:	

Please direct all correspondence in this case to Merchant & Gould P.C. at the address indicated below:

Merchant & Gould P.C.  
P.O. Box 2903  
Minneapolis, MN 55402-0903



I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

2	Full Name Of Inventor	Family Name Manlapig	First Given Name Emmanuel	Second Given Name Salvador Viana
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1	Mailing Address	Address 8 Tucker Street	City Chapel Hill	State & Zip Code/Country QLD 4069 Australia
Signature of Inventor 201:			Date:	
2	Full Name Of Inventor	Family Name Vargas	First Given Name Alfredo	Second Given Name Percy
0	Residence & Citizenship	City La Paz	State or Foreign Country Bolivia	Country of Citizenship Bolivia
2	Mailing Address	Address Calle 4A, No. 23 Meseta Achumani	City La Paz	State & Zip Code/Country Bolivia
Signature of Inventor 202:			Date:	

MERCHANT &amp; GOULD P.C.

## United States Patent Application

## COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that

I verily believe I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: COLLECTORLESS FLOTATION

The specification of which

- a. ☐ is attached hereto  
b. ☒ was filed on March 13, 2001 as application serial no. \_\_\_\_\_ and was amended on \_\_\_\_\_ (if applicable) (in the case of a PCT-filed application) described and claimed in international no. PCT/AU99/00772 filed September 14, 1999 and as amended on \_\_\_\_\_ (if any), which I have reviewed and for which I solicit a United States patent.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119/365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on the basis of which priority is claimed:

- a. ☐ no such applications have been filed.  
b. ☒ such applications have been filed as follows:

## FOREIGN APPLICATION(S), IF ANY, CLAIMING PRIORITY UNDER 35 USC § 119

COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	DATE OF ISSUE (day, month, year)
Australia	PP 5943	September 15, 1998	

## ALL FOREIGN APPLICATION(S), IF ANY, FILED BEFORE THE PRIORITY APPLICATION(S)

COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	DATE OF ISSUE (day, month, year)

I hereby claim the benefit under Title 35, United States Code, § 120/365 of any United States and PCT international application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. APPLICATION NUMBER	DATE OF FILING (day, month, year)	STATUS (patented, pending, abandoned)

I hereby claim the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below:

U.S. PROVISIONAL APPLICATION NUMBER	DATE OF FILING (Day, Month, Year)

I acknowledge the duty to disclose information that is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, § 1.56 (reprinted below):

**§ 1.56 Duty to disclose information material to patentability.**

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is canceled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is canceled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) the closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made of record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim;

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application:

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

(e) In any continuation-in-part application, the duty under this section includes the duty to disclose to the Office all information known to the person to be material to patentability, as defined in paragraph (b) of this section, which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.



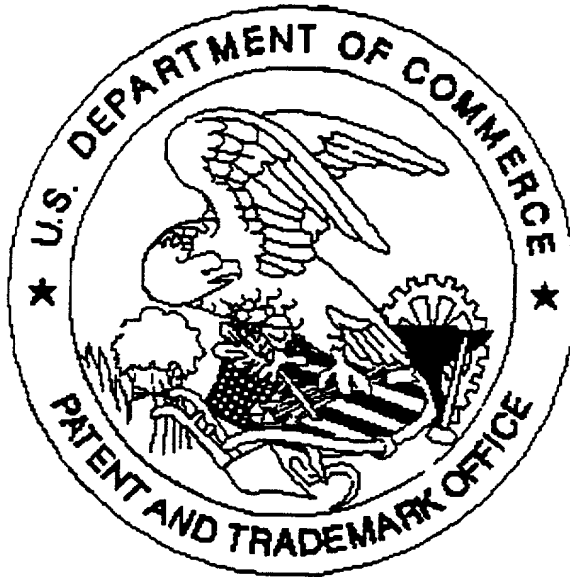
I hereby appoint the following attorney(s) and/or patent agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith:

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Leon, Andrew J.	Reg. No. 46,869	Zeuli, Anthony R.	Reg. No. 45,255

I hereby authorize them to act and rely on instructions from and communicate directly with the person/assignee/attorney/firm/ organization who/which first sends/sent this case to them and by whom/which I hereby declare that I have consented after full disclosure to be represented unless/until I instruct Merchant & Gould P.C. to the contrary.

I understand that the execution of this document, and the grant of a power of attorney, does not in itself establish an attorney-client relationship between the undersigned and the law firm Merchant & Gould P.C., or any of its attorneys.

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